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(54) Abstract Title
Handover of a mobile unit in a wireless local area network

(57) Disclosed in the present invention is a method for supporting mobility of a mobile node between subnetworks in a wireless local area network that includes a plurality of subnetworks networked through Internet and assigns a different Internet protocol (IP) address to the plural subnetworks, respectively, the method comprising the steps of: if the mobile node moves arbitrarily to a second subnetwork from a first subnetwork during communication, broadcasting a first message, in which a foreign mobile access server (MAS) of the second subnetwork includes the mobile node's medium access control (MAC) address; acquiring, at a home mobile access server of the first subnetwork, an address of the foreign mobile access server from the first message, and then transmitting a second message including an address of the home mobile access server and an Internet protocol address of the mobile node to the foreign mobile access server in reply to the first message; and routing, at the foreign mobile access server and the home mobile access server, the mobile node's data by using the other party's address.

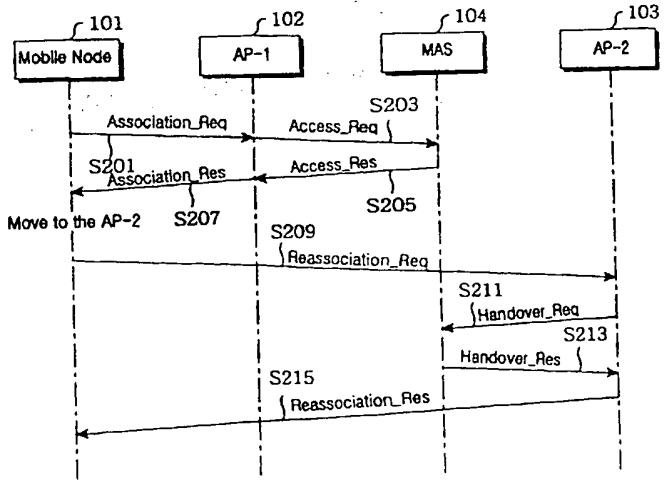

FIG.2

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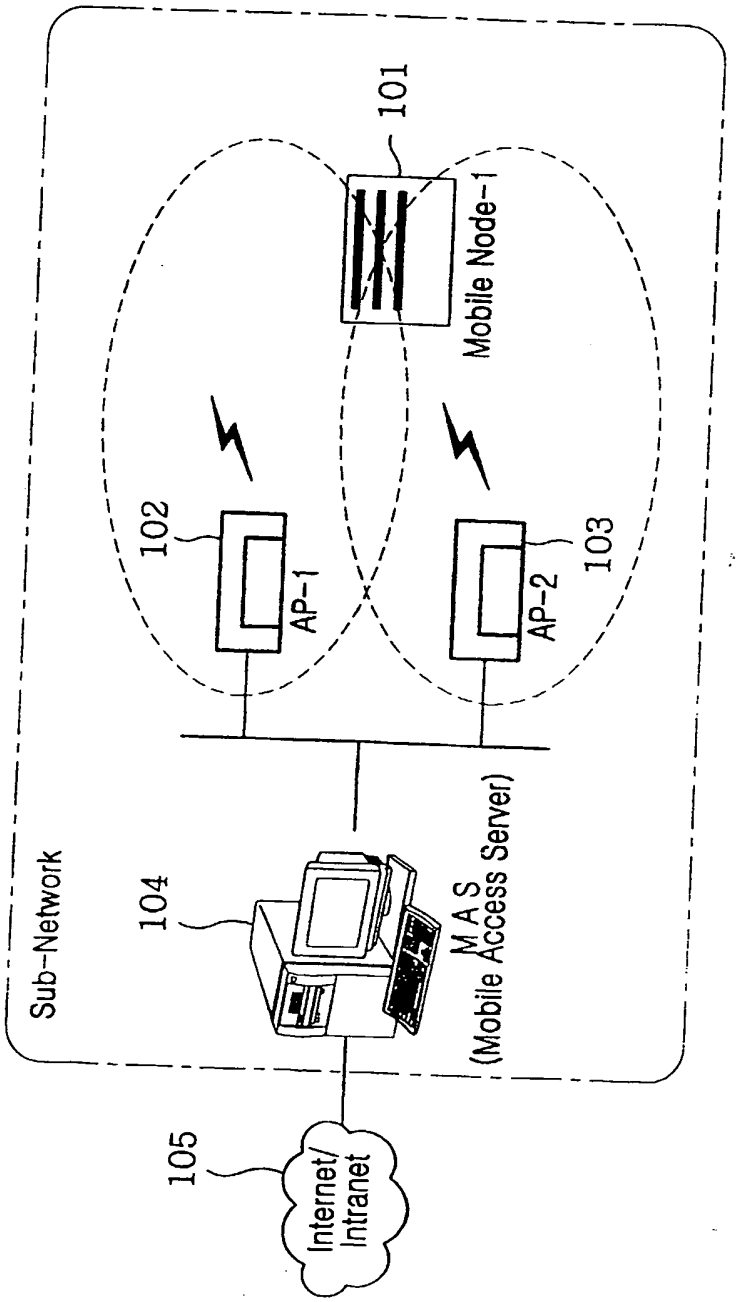
101
Mobile Node-1
102
AP-1
103
AP-2
104
MAS
(Mobile Access Server)
Sub-Network
105
Internet/
Intranet

FIG.1

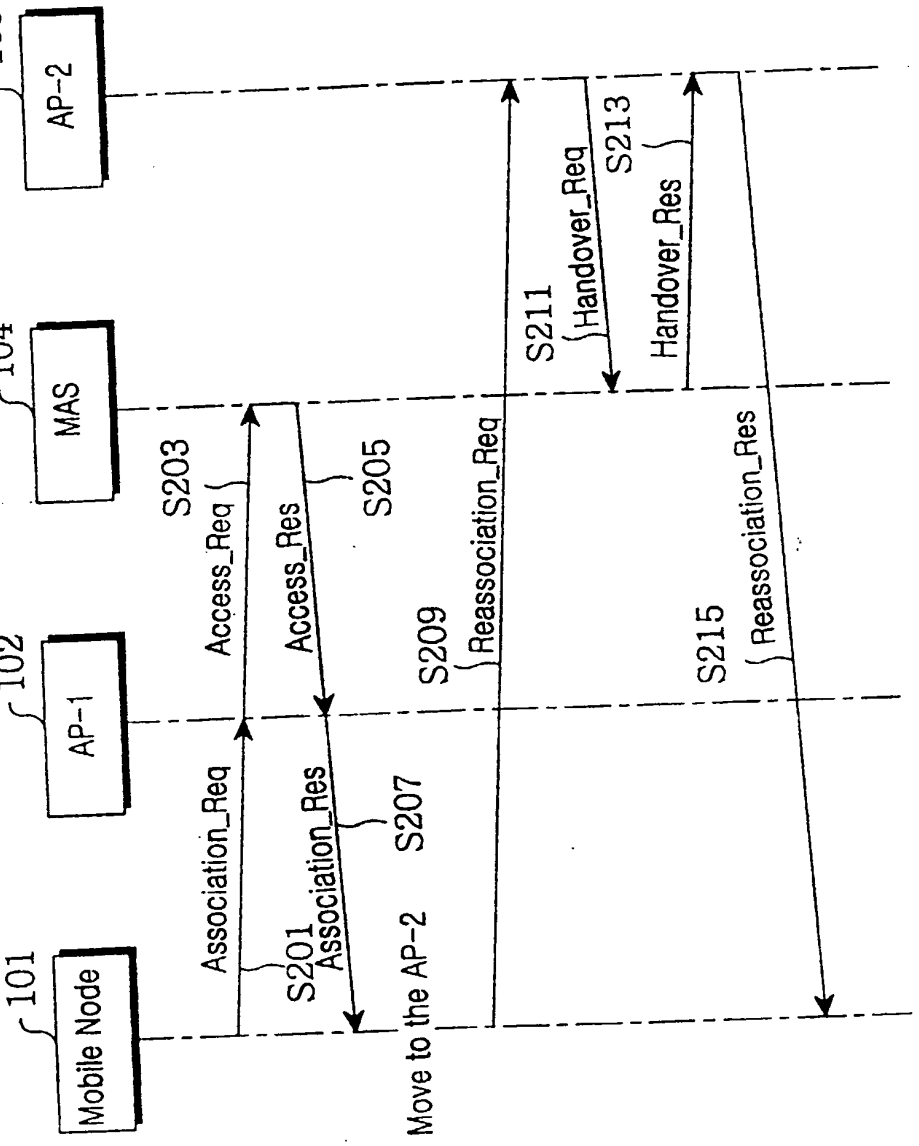
101
Mobile Node
102
AP-1
104
MAS
103
AP-2
Association_Req
S201
Association_Res
S207
Move to the AP-2
Access_Req
S203
Access_Res
S205
S209
Reassociation_Req
S211
Handover_Req
S213
Handover_Res
S215
Reassociation_Res

FIG.2

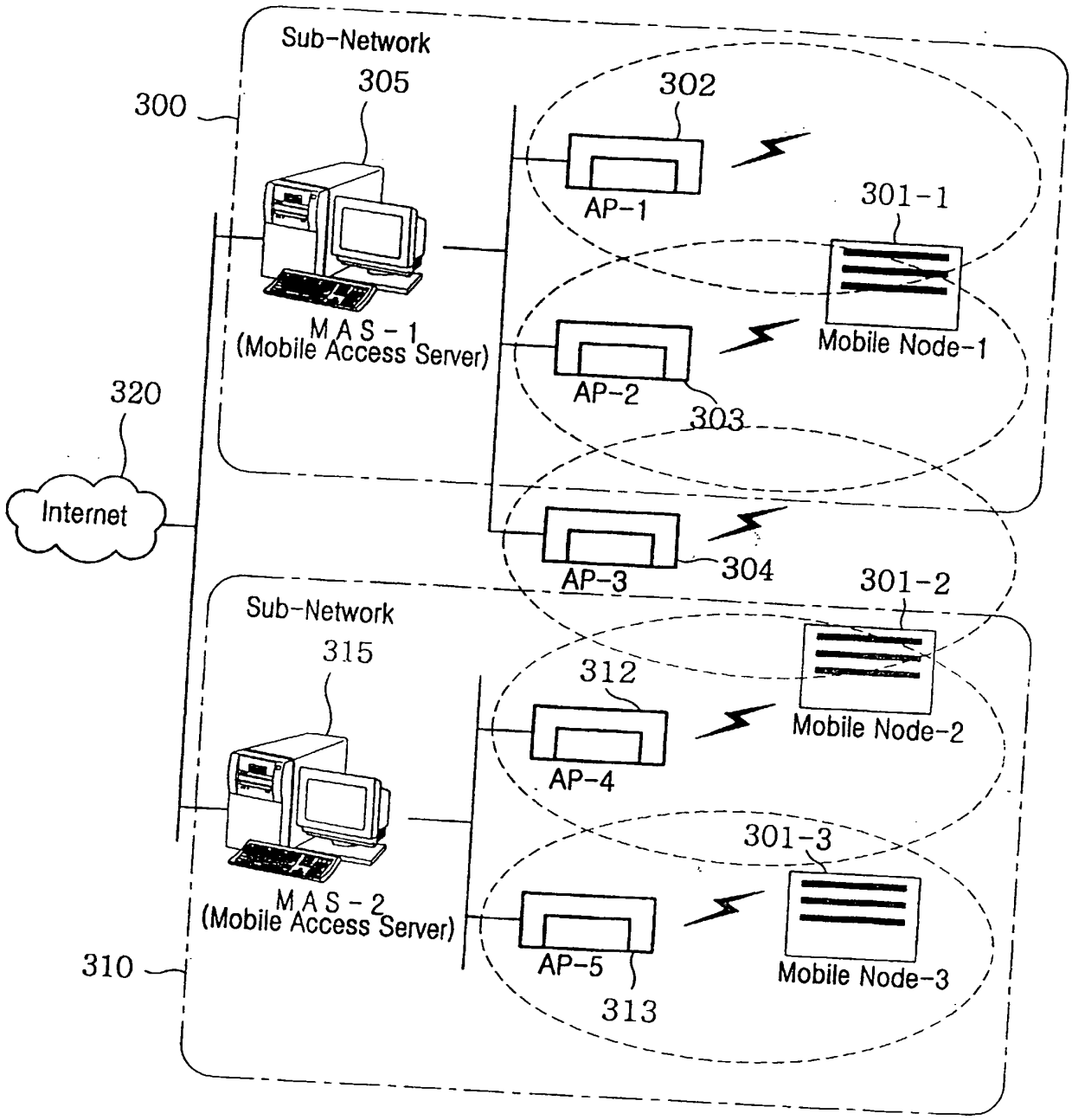
Sub-Network
305
300
302
AP-1
301-1
MAS-1
(Mobile Access Server)
Mobile Node-1
AP-2
303
320
Internet
AP-3
304
301-2
Sub-Network
315
312
Mobile Node-2
AP-4
301-3
MAS-2
(Mobile Access Server)
AP-5
Mobile Node-3
310
313

FIG.3

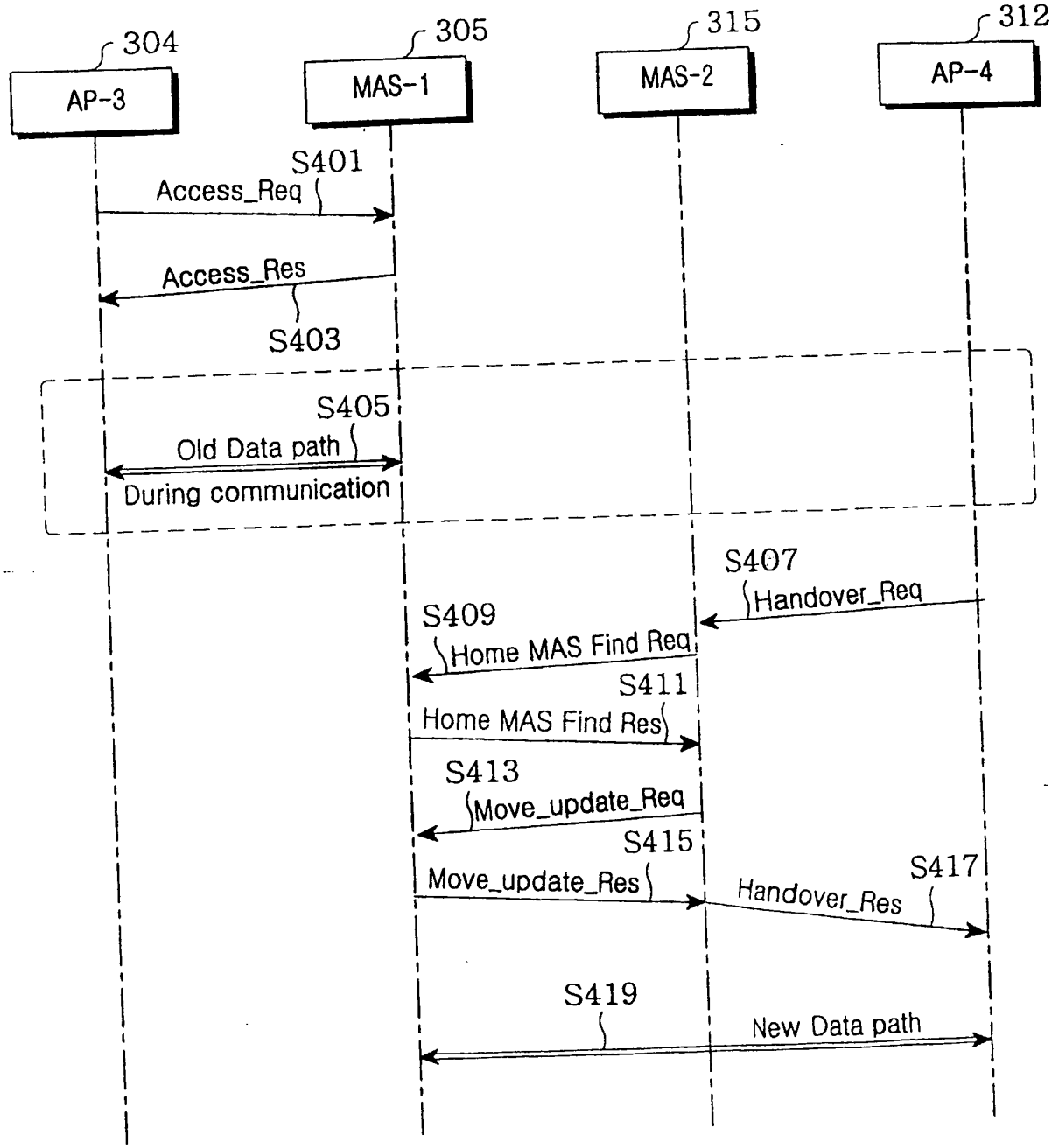
304
AP-3
305
MAS-1
315
MAS-2
312
AP-4
S401
Access_Req
Access_Res
S403
S405
Old Data path
During communication
S407
Handover_Req
S409
Home MAS Find Req
S411
Home MAS Find Res
S413
Move_update_Req
S415
Move_update_Res
S417
Handover_Res
S419
New Data path

FIG.4

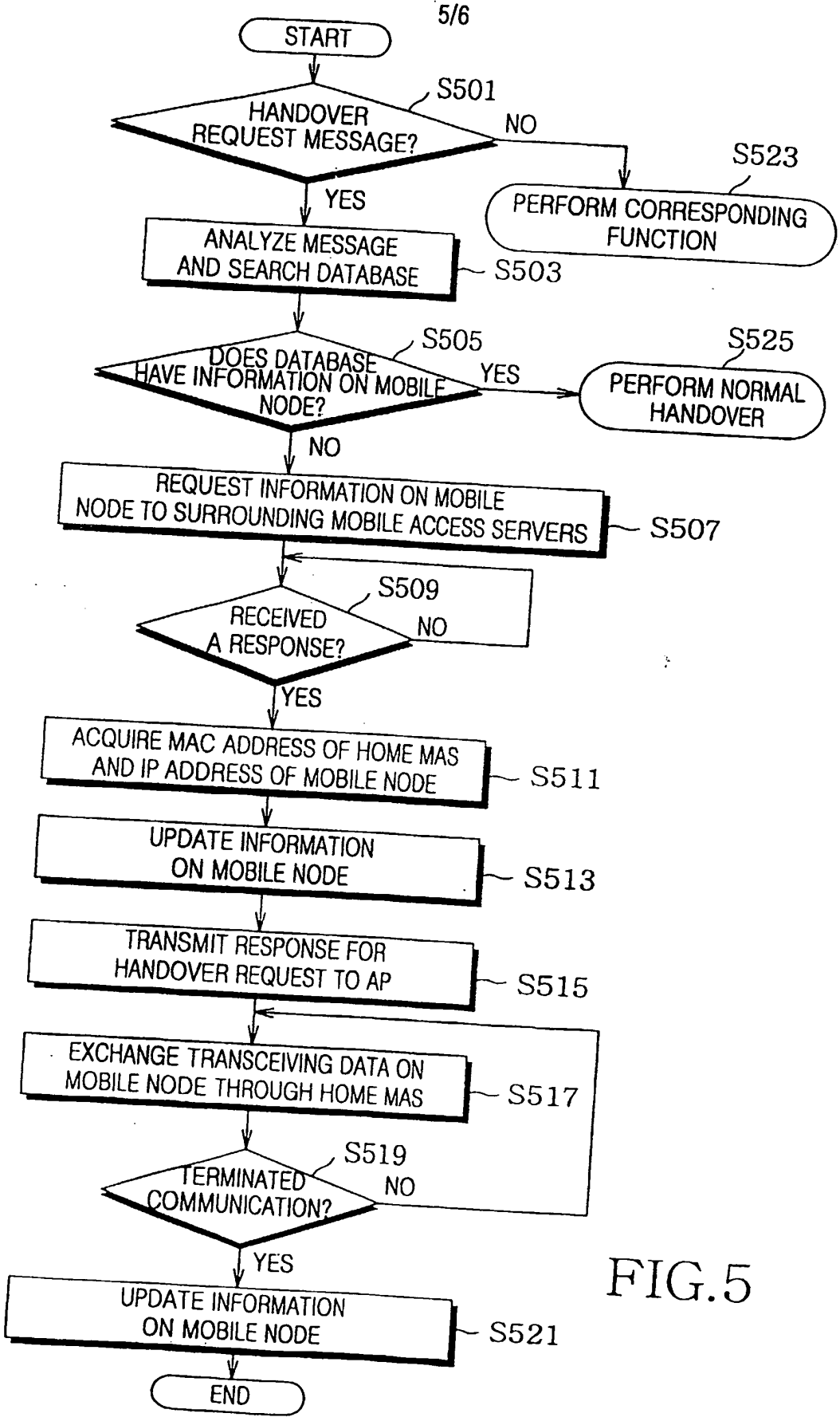
START
HANDOVER REQUEST MESSAGE?
S501
NO
YES
PERFORM CORRESPONDING FUNCTION
S523
ANALYZE MESSAGE AND SEARCH DATABASE
S503
DOES DATABASE HAVE INFORMATION ON MOBILE NODE?
S505
YES
PERFORM NORMAL HANDOVER
S525
NO
REQUEST INFORMATION ON MOBILE NODE TO SURROUNDING MOBILE ACCESS SERVERS
S507
RECEIVED A RESPONSE?
S509
NO
YES
ACQUIRE MAC ADDRESS OF HOME MAS AND IP ADDRESS OF MOBILE NODE
S511
UPDATE INFORMATION ON MOBILE NODE
S513
TRANSMIT RESPONSE FOR HANDOVER REQUEST TO AP
S515
EXCHANGE TRANSCEIVING DATA ON MOBILE NODE THROUGH HOME MAS
S517
TERMINATED COMMUNICATION?
S519
NO
YES
UPDATE INFORMATION ON MOBILE NODE
S521
END

FIG.5

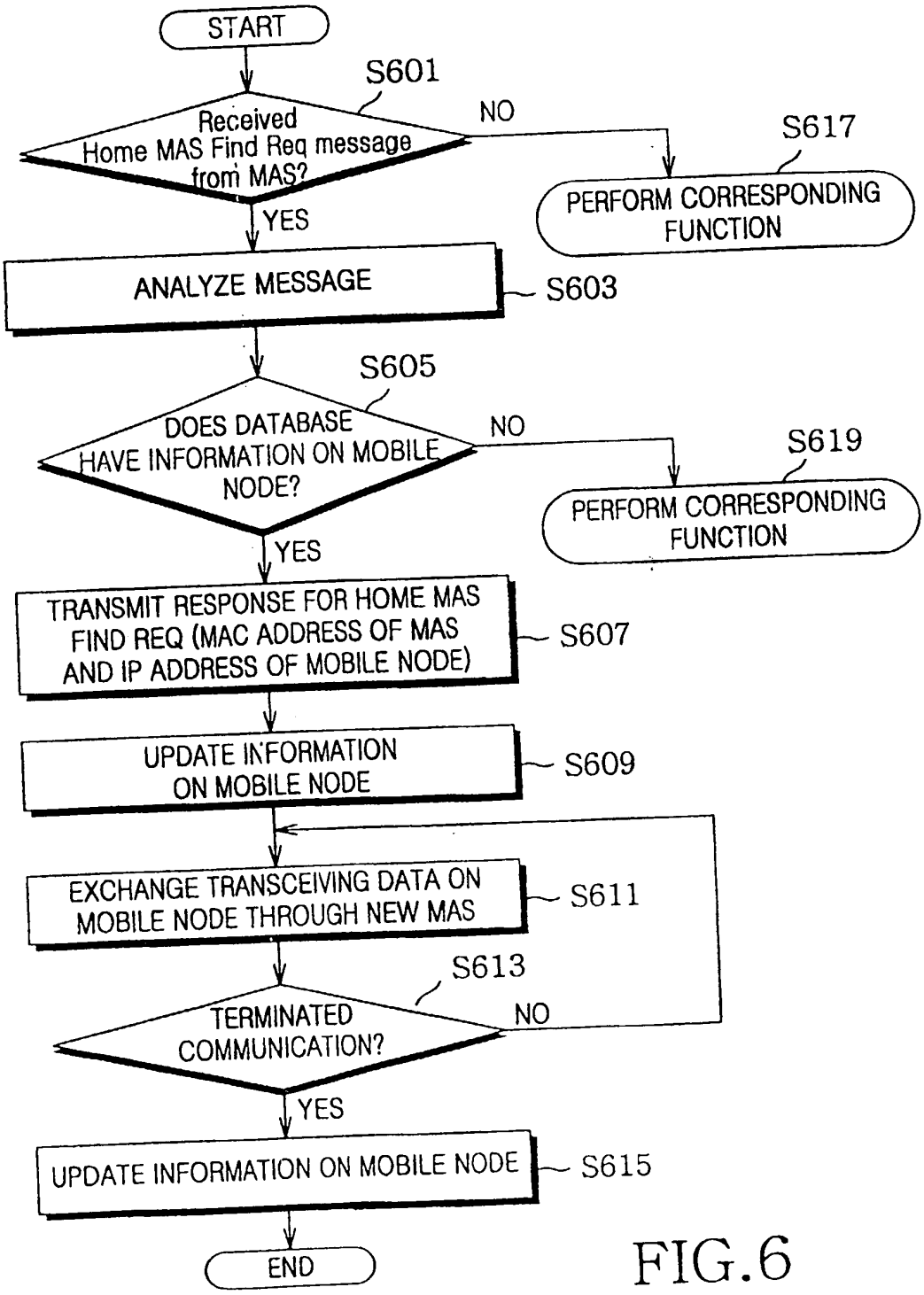
START
S601
Received Home MAS Find Req message from MAS?
NO
S617
PERFORM CORRESPONDING FUNCTION
YES
ANALYZE MESSAGE
S603
S605
DOES DATABASE HAVE INFORMATION ON MOBILE NODE?
NO
S619
PERFORM CORRESPONDING FUNCTION
YES
TRANSMIT RESPONSE FOR HOME MAS FIND REQ (MAC ADDRESS OF MAS AND IP ADDRESS OF MOBILE NODE)
S607
UPDATE INFORMATION ON MOBILE NODE
S609
EXCHANGE TRANSCEIVING DATA ON MOBILE NODE THROUGH NEW MAS
S611
S613
TERMINATED COMMUNICATION?
NO
YES
UPDATE INFORMATION ON MOBILE NODE
S615
END

FIG.6

APPARATUS AND METHOD FOR SUPPORTING MOBILITY BETWEEN SUBNETWORKS OF MOBILE NODE IN WIRELESS LAN

The present invention relates generally to wireless local area network (WLAN), and more particularly, though not exclusively, to an apparatus and a method for supporting mobility of a mobile node between foreign subnetworks in the local area network.

By way of explanation a subnetwork will be hereinafter presumed to be a small network unit that is divided by a gateway in a private network. Typically, a mobility of a mobile node is supported within the same subnetwork only, and the applied technology thereof has been supported by using medium access control (MAC) level data on Ethernet or 802.3, but not through mobility support on IP (Internet Protocol).

It will be understood that a mobile node in a wireless local area network can correspond to a mobile computer such as a notebook computer, laptop computer, tablet computer, hand-held computer, wearable computer, or other type of portable computer device. Also, a mobile node in a wireless local area network can correspond to a mobile telephone, a pager, a text-messaging device, a communication unit such as a semiconductor chip for communications, or other type of portable communication apparatus.

Furthermore a mobile node can correspond to any unit that can be in communication with a wireless network. A mobile node may be known by many different names, such as mobile terminal, mobile computing device, mobile station,

remote unit, mobile unit, or a mobile user station, for example.

A mobile node communicates with a wireless local area network (WLAN) using a network interface card (NIC). Access points manage wireless resources in a subnetwork of a wireless local area network. The access points exchange information with a mobile node through a wireless link. A mobile access server controls access points, and supports signal protocol, for example, call set and call release. A mobile access server (MAS) includes a gateway for communication with Internet and/or Intranet.

Likewise there is currently a lack of convenient and efficient support for a mobility of a mobile node. Efforts have been made to improve features related to mobile terminals.

Exemplars of recent efforts in the art are disclosed, for example, in U.S. Patent No. 6,447,156 to Ala-Laurila *et al.*, entitled *APPARATUS AND ASSOCIATED METHOD FOR SELECTABLY OPERATING RADIO DEVICE I ALTERNATE OPERATING MODE*, issued on November 5, 2002, U.S. Patent No. 6,473,413 to Chiou *et al.*, entitled *METHOD FOR INTER-IP-DOMAIN ROAMING ACROSS WIRELESS NETWORKS*, issued on October 29, 2002, U.S. Patent No. 6,360,264 to Rom, entitled *METHOD AND APPARATUS FOR MAINTAINING CONNECTIVITY OF NODES IN A WIRELESS LOCAL AREA NETWORK*, issued on March 19, 2002, U.S. Patent No. 6,188,681 to Vesuna, entitled *METHOD AND APPARATUS FOR DETERMINING ALTERNATIVE SECOND STATIONARY ACCESS POINT IN RESPONSE TO DETECTING IMPEDED WIRELESS CONNECTION*, issued on February 13, 2001, U.S. Patent No. 6,061,563 to Lee, entitled

METHOD OF MOVING STATION IN WIRELESS LAN, issued on May 9, 2000, U.S. Patent No. 6,006,090 to Coleman *et al.*, entitled *PROVIDING ROAMING CAPABILITY FOR MOBILE COMPUTERS IN A STANDARD NETWORK*, issued on December 21, 1999, and U.S. Patent No. 5,724,346 to Kobayashi *et al.*, entitled *MEANS FOR MAINTAINING CONNECTABLE ACCESS POINTS OWING TO MOVEMENT OF A MOBILE STATION BETWEEN CELLS IN A WIRELESS LAN SYSTEM*, issued on March 3, 1998.

While these contemporary efforts contain merit/significance/value further improvements would be advantageous.

Some products may support mobility in the same subnetwork. That is, some products may support handover between access networks in the one network using the same gateway. However, some such products do not provide an adequately improved method and apparatus for conveniently and efficiently supporting mobility between foreign subnetworks.

In an attempt to discuss and solve the problem related to a handoff from one subnetwork to a different subnetwork, "Mobile IPv4" could be considered. "Mobile IPv4" is mobile Internet protocol, version 4. However, the mobile node should be supported with mobility as well, in order to support the "Mobile IPv4". That is, the "Mobile IPv4" cannot be used in the absence of support for the mobile node. Another possible problem concerned here is that it takes too much time to convert the data path because the mobile access server should have a "Mobile Agent" including home agent (HA)/foreign agent (FA) to support mobility, and a tunnelling structure should be implemented between those two agents.

Hence, a new, improved, convenient, and efficient scheme for supporting mobility of a mobile node between foreign subnetworks is needed, which does not have to be as complicated as the "Mobile IPv4" or changing the mobile node.

Furthermore it is known that it can be difficult, inconvenient, inefficient and/or unnecessarily complicated to move a mobile node between subnetworks of a wireless local area network.

It is an aim of embodiments of the present invention to at least partly mitigate the above-referenced problems.

According to a first aspect of the present invention there is provided a method of communication for a mobile node, the method comprising:

moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first and second subnetworks being networked to each other through the Internet, the first subnetwork being assigned a first Internet protocol address, the second subnetwork being assigned a second Internet protocol address different from the first Internet protocol address;

broadcasting a first message from a second mobile access server of the second subnetwork, the first message including a medium access control address of the mobile node;

acquiring an address of the second mobile access server from the first message, said acquiring being performed by a first mobile access server of the first subnetwork;

transmitting a second message from the first mobile access server to the second mobile access server in response to the first message, the second message including an address of the first mobile access server and an Internet protocol address of the mobile node; and

when the mobile node is in the second subnetwork, routing first data from the mobile node through the second mobile access server and then through the first mobile access server.

According to a second aspect of the present invention there is provided a handover processing method for a mobile node, the method comprising:

moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first and second subnetworks being networked to each other through the Internet and the first and second subnetworks not being assigned the same Internet protocol address;

transmitting a handover request message from an access point of the second subnetwork to a second mobile access server of the second subnetwork, the handover request message including a medium access control address of the mobile node;

broadcasting a first message from the second mobile access server in response to the handover request message, the first message including a medium access control address of the mobile node;

when a second message is received in response to the first message, acquiring an address of a first mobile access server of the first subnetwork and an Internet protocol address of the mobile node from the second message; and

when the mobile node is in the second subnetwork, routing data from the mobile node through the address of the first mobile access server.

According to a third aspect of the present invention there is provided a handover processing method for a mobile node, the method comprising:

moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first and second subnetworks being networked to each other through the Internet and the first and second subnetworks not being assigned the same Internet protocol address;

receiving a first message at a first mobile access server of the first subnetwork, the first message including an address of the first mobile node;

acquiring an address of a second mobile access server of the second subnetwork from the first message received, said acquiring being performed by the first mobile access server;

transmitting a second message to the second mobile access server in dependence upon said acquiring of the address of the second mobile access server, the second message including an address of the first mobile access server and an Internet protocol of the mobile node; and

routing data from the mobile node through the address of the second mobile access server acquired by the first mobile access server.

According to a fourth aspect of the present invention there is provided an apparatus for mobile communication, the apparatus comprising:

a first subnetwork being in a wireless local area network, being in communication with the Internet, and being assigned a first Internet protocol address;

a second subnetwork being in the wireless local area network, being in communication with the Internet, and being assigned a second Internet protocol address different from the first Internet protocol address;

a foreign mobile access server being mounted in said second subnetwork and broadcasting a first message including a medium access control address of a mobile node when the mobile node moves to said second subnetwork from said first subnetwork; and

a home mobile access server being mounted in said first subnetwork, acquiring an address of said foreign mobile access server from the first message, said home mobile access server transmitting a second message in response to the first message, the second message including an address of said home mobile access server and an Internet protocol address of the mobile node to said foreign mobile access server; wherein

said foreign mobile access server is arranged to route first data from the mobile node to the home mobile access server; and

said home mobile access server is arranged to route second data through the foreign mobile access server and then to the mobile node.

Embodiments of the present invention provide an improved apparatus and method that enables a mobile node to be conveniently moved from a first subnetwork in a wireless local area network (WLAN) to a second subnetwork in the wireless local area network.

Embodiments of the present invention provide an apparatus and a method for supporting mobility of a mobile node between foreign subnetworks within a wireless local area network.

Embodiments of the present invention provide a method for supporting mobility of a mobile node between subnetworks in a wireless local area network that includes a plurality of subnetworks networked through Internet and assigns a different Internet protocol (IP) address to each of the plural subnetworks, the method comprising: when the mobile node moves arbitrarily to a second subnetwork from a first subnetwork during communication, broadcasting a first message, in which a foreign mobile access server (MAS) of the second subnetwork includes the mobile node's medium access control (MAC) address or/and previous access point address; acquiring, at a home mobile access server of the first subnetwork, an address of the foreign mobile access server from the first message, and transmitting a second message including an address of the home mobile access server and an Internet protocol address of the mobile node to the foreign mobile access server in reply to the first message; and routing, at the foreign mobile access server and the home mobile access server, the mobile node's data by using the other party's address.

The present invention is more specifically described in the following paragraphs by reference to the drawings attached only by way of example. Other advantages and features will become apparent from the following description and from the claims.

In the accompanying drawings, which are incorporated in and constitute a part of this specification, embodiments of the invention are illustrated, which, together with a general description of the invention given above, and the detailed description given below, serve to exemplify the principles of this invention.

Fig. 1 is a schematic diagram of a lower subnetwork in an exemplary wireless local area network;

Fig. 2 depicts an exemplary flow of supporting mobility within one subnetwork in a wireless local area network;

Fig. 3 is a schematic diagram of a wireless local area network including a plurality of subnetworks, in accordance with the principles of the present invention;

Fig. 4 diagrammatically depicts signal messages that are exchanged between components when a mobile node moves to a foreign subnetwork from home subnetwork in the wireless local area network, in accordance with the principles of the present invention;

Fig. 5 is a flow chart illustrating handover that is performed by a foreign mobile access server (MAS), in accordance with the principles of the present invention; and

Fig. 6 is a flow chart illustrating handover that is performed by a home mobile access server, in accordance with the principles of the present invention.

While the present invention will be described more fully hereinafter with reference to the accompanying drawings, in which details of the present invention are shown, it is to be understood at the outset of the description which follows that persons of skill in the appropriate arts may modify the invention here described while still achieving the favourable results of this invention. Accordingly, the description which follows is to be understood as being a broad, teaching disclosure

directed to persons of skill in the appropriate arts, and not as limiting upon the present invention.

Illustrative embodiments of the invention are described below. In the interest of clarity, not all features of an actual implementation are described. In the following description, well-known functions, constructions, and configurations are not described in detail since they could obscure the invention with unnecessary detail.

Fig. 1 depicts the configuration of a lower subnetwork in an exemplary wireless local area network. The subnetwork includes a mobile node 101, access points (AP) 102 and 103, and a mobile access server (MAS) 104. Referring to Fig. 1, mobile node 101 indicates a mobile node that is in communication with a wireless local area network (WLAN) through the use of a network interface card (NIC). Access points 102, 103 manage wireless resources, and practically, exchange information with a mobile node through a wireless link. Mobile access server 104 controls access points, and supports signal protocol, for example, call set and call release. Moreover, the mobile access server 104 includes a gateway (not shown) for communication with Internet/Intranet 105.

A mobile node can be handed off from a first access point 102 to a second access point 103 in the one subnetwork having the above-described configuration. However, the mobile node cannot be handed off to a different subnetwork. The flow or procedure for supporting mobility within the same one subnetwork is depicted in Fig. 2. Namely, Fig. 2 is a flow chart of handover procedure concerned in a case where a mobile node moves from the first access point's service area to

the second access point's service area, in one subnetwork.

Referring to Fig. 2, at step S201, the mobile node 101 transfers an association request message (Association_Req) to a first access point 102 for communication with the first access point 102. Then, at step S203, the first access point 102 transfers an access request message (Access_Req) to the mobile access server 104 to inform that the mobile node wants an association. Having received the Access_Req, the mobile access server 104 confirms whether a location move request message for the mobile node is normal, and updates the location data related to the mobile node and then updates a service pass (message routing information) for the mobile node, thereby performing data transmission concerning the mobile node. At step S205, the mobile access server 104 sends an access response message (Access_Res) to the first access point 102 in reply to the Access_Req. At step S207, the first access point 102 transmits an association response message (Association_Res) to the mobile node 101 in reply to the Association_Req. Once the association is set in such manner, the mobile node 101 performs communication through the first access point 102.

If the mobile node moves to another access point, that is, a second access point, that is within the same one subnetwork, the mobile node 101 concludes that the signal intensity of the first access point has been weakened, and scans another new access point until it acquires a signal of the second access point 103. At step S209, the mobile node 101 transmits a reassociation request message (Reassociation_Req) to the second access point 103, and the second access point 103 transmits a

handover request message (Handover_Req) to the mobile access server 104. Then, the mobile access server 104 updates data on location registration (Location_registration) of the mobile node, and changes the data path to the mobile node, namely from the first access point to the second access point. At step S211, the second access point 103 transmits a handover request message (Handover_Res). At step S213, the mobile access server 104 transmits a handover response message (Handover_Res) to the second access point 103 in reply to the Handover_Req. Later, at step S215, the second access point 103 sends a reassociation response message (Reassociation_Res) to the mobile node 101 to notify that the handover has been completed. In this way, the handover is duly completed, and the mobile node 101 can perform communication through the second access point 103.

Described below is a manner for supporting mobility of a mobile node between foreign subnetworks within a private network, for example, a wireless local area network in accordance with an embodiment of the present invention. Here, the term "subnetwork" means a small network unit that is divided by a gateway. Here, a mobile node can communicate with a second node through the Internet. Here, the second node, also known as a communication node, can be any node or terminal or unit that is connected to the Internet and that is in communication with the mobile node. When data is sent from the mobile node to the communication node, the communication node is the destination node. When data is sent from the communication node to the mobile node, the communication node is the origination node.

Fig. 3 is a schematic diagram of a wireless local area network including a plurality of subnetworks, in accordance with the principles of the present invention. As shown in the drawing, a first subnetwork 300 includes a first access point (AP) 302, a second access point 303, a third access point 304, and a first mobile access server (MAS) 305. A second subnetwork 310 includes a fourth access point 312 and a fifth access point 313. Here, the first mobile access server 305 and the second mobile access server 315 are networked through the Internet 320.

The mobile nodes 301-1, 301-2, and 301-3 indicate mobile nodes mounted with a wireless local area network using network interface card (NIC). The access points 302, 303, 304, 312, and 313 manage wireless resources, and practically exchange information with mobile nodes through a wireless link. The access points basically support bridge function between a wired local area network and a wireless local area network, and forward request messages from a mobile node to a mobile access server (MAS).

Mobile access server 305 controls the first access point 302, the second access point 303, and the third access point 304. Another mobile access server 315 controls the fourth access point 312 and the fifth access point 313. Here, the mobile access servers 305 and 315 support a plurality of protocols (call setup, call release, mobility, management, and security), and manage information on the access points and the mobile node, and perform data path switching and Internet protocol assignment. Also, the mobile access servers 305 and 315 include a gateway (not shown) for communicating with Internet 320.

The following explains the operation based on the above-described constitution. Fig. 4 diagrammatically depicts signal messages that are exchanged between components when a mobile node moves to a foreign subnetwork from home subnetwork in the wireless local area network, in accordance with the principles of the present invention. Fig. 4 shows handover procedure, or flow, when a mobile node moves from the third access point 304 service area of the first subnetwork 300 to the fourth access point 312 service area of the second subnetwork 310.

The first mobile access server 305 can be referred to as the home mobile access server 305. The second mobile access server 315 can be referred to as the foreign mobile access server 315.

At step S401, with reference to Fig. 4, the third access point 304, having received an association request from the mobile node 301-2, transmits an access request message (Access_Req) to the first mobile access server 305 for notifying that the mobile node 301-2 has requested an association. After receiving the Access_Req, the first mobile access server 305 updates management data for communicating, and allows the service to the mobile node. And, at step S403, the first mobile access server 305 transmits an access response (Access_Res) to the third access point 304 in reply to the Access_Req. Then, the third access point 304 transmits a response to the Association_Req to the mobile node 301-2. At step S405, when the association is set, the mobile node 301-2 performs communication through the third access point 304 and the first mobile access server 305.

If the mobile node 301-2 moves to the service area of the fourth access point 312 while communicating with a second node or communication node through the Internet 320, the mobile node 301-2 concludes that the signal intensity of the third access point 304 has been weakened, and scans for another access point until it acquires a signal of the fourth access point 312. The mobile node 301-2 transmits a reassociation request message (Reassociation_Req) to the fourth access point 312. At step S407, the fourth access point 312 transmits a handover request message (Handover_Req) from the mobile node 301-2 to the second mobile access server 315.

The Handover_Req includes a physical address, for example, medium access control (MAC) address, and/or the Internet protocol address of the third access point 304 for identifying the mobile node 301-2. The second mobile access server 315, having received the Handover_Req, checks to determine whether the information on the mobile node 301-2 is stored in its own database.

At step S409, when it turns out that there is no such information, the second mobile access server 315 broadcasts Home mobile access server (MAS) Find request message to surrounding mobile access servers (for example, the first mobile access server 305) to acquire the Internet protocol address of the mobile node 301-2. An arbitrarily defined protocol can be used for the Home mobile access server (MAS) Find request message broadcast from the second mobile access server 315. Also, reverse address resolution protocol (RARP) can be used for the Home mobile access server (MAS) Find request message broadcast from the second mobile access server 315. The reverse address resolution protocol (RARP) maps a

hardware address, such as a medium access control address, to an Internet address.

The Home mobile access server (MAS) Find request message broadcast from the second mobile access server 315 can include the medium access control (MAC) address of the mobile node 301-2. At step S411, the first mobile access server 305 that received the Home mobile access server (MAS) Find request message transfers a Home mobile access server (MAS) Find response message including the medium access control (MAC) address and Internet protocol address of the first mobile access server 305 to the second mobile access server 315. At this point, the second mobile access server 315 acquires the medium access control (MAC) address and Internet protocol address of the Home mobile access server (MAS) 305, and the Internet protocol address of the mobile node 301-2.

At step S413, to update the information for supporting mobility, the second mobile access server 315 requests the first mobile access server 305 to update the information for supporting mobility. At step S415, the first mobile access server 305 responds to the update request.

In this way, information in connection with authentication between mobile access servers 305 and 315 and the mobile node 301-2, which are required for mobility, can be updated. At step S417, the second mobile access server 315 transmits a response message to the fourth access point 312 in reply to the Handover_Req, and terminates the handover. At step S419, once the handover is terminated, the mobile node 301-2 performs communication through the fourth access point 312, the

second mobile access server 315, and the first mobile access server 305 on the newly established data path.

5 performed by a foreign mobile access server (MAS), in an access server in a new direction to which a mobile unit moved, and the Home mobile access server 305 is a initial association request.

At step S501, with reference to Fig. 5, the foreign mobile access server (MAS) 315 sends out if a Handover_Req from a newer access point has been received. At step S503, when the Handover_Req has been received, the foreign mobile access server 315 performs a relevant or appropriate function corresponding to the circumstances. At step S503, when the Handover_Req has been received, the foreign mobile access server 315 analyses the Handover_Req received from the access point.

At step S505, the foreign mobile access server 315, of the mobile node 301 identifier in the Handover_Req, node 301-2 is stored in its own database. At step S525, if the information exists, the foreign mobile access server 315 performs a normal handover. At step S507, however, if there is no such information, the foreign mobile access server 315 broadcasts a Home mobile access server (MAS) Find request message to surrounding mobile access server 305, to enable the

At step S509, after broadcasting the Home mobile access server (MAS) Find request message, the foreign mobile access server 315 checks to determine whether a response message to the Home mobile access server (MAS) Find request message has been received. At step S511, if the Home mobile access server (MAS) Find request message has been received, the foreign mobile access server 315 acquires the medium access control (MAC) address and Internet protocol address of the Home mobile access server 305, and also acquires the Internet protocol address of the mobile node 301-2 from the response message.

Afterwards, the foreign mobile access server 315 requests the Home mobile access server to update information on the mobile node's location/route. At step S513, the foreign mobile access server 315 updates information in the database in connection with authentication between mobile access servers 305 and 315 and the mobile node 301-2 that are required for mobility.

At step S515, after updating the information for supporting mobility, the foreign mobile access server 315 transmits a response message (that is, Handover_Res) to the fourth access point 312 in reply to the Handover_Req to terminate the handover. At step S517, transceiving data is exchanged on mobile node 301-2 through home MAS 305. That is, at step S517, once the handover is terminated, the foreign mobile access server 315 exchanges transceiving data for the mobile node 301-2 through the Home mobile access server 305.

When the mobile node 301-2 was in the area of the first subnetwork 300, the mobile node 301-2 had established a communication path with a second node or

communication node, the communication node was connected to the Internet 320, and data was being transmitted from the mobile node 301-2 through the access point 304, the home mobile access server 305, the Internet 320, and to the communication node. Also, data was being transmitted from the communication node through the Internet 320, the home mobile access server 305, the access point 304, and to the mobile node 301-2.

At step S517, the mobile node 301-2 has been moved to the area of the second subnetwork 310, the mobile node 301-2 has established a new communication path with the communication node, the communication node is still connected to the Internet 320, and data is being transmitted from the mobile node 301-2 through the access point 312, the foreign mobile access server 315, the home mobile access server 305, the Internet 320, and to the communication node. Also, data is being transmitted from the communication node through the Internet 320, through the home mobile access server 305, through the foreign mobile access server 315, through the access point 312, and to the mobile node 301-2.

The transmitted data from the mobile node 301-2 is sent to the other party or destination node, also known as the communication node, through the fourth access point 312, the foreign mobile access server 315, and the Home mobile access server 305. And, the data being transmitted from the other party or communication node is sent back to the mobile node 301-2 through the Home mobile access server 305, the foreign mobile access server 315, and the fourth access point 312.

Later, at step S519, the foreign mobile access server 315 checks to determine whether the communication

for the mobile node 301-2 has been terminated. At step S521, when the communication for the mobile node 301-2 has been terminated, the foreign mobile access server 315 updates information on the mobile node 301-2 that has been stored in the database, and the whole procedure is finished here.

Fig. 6 is a flow chart illustrating handover that is performed by a home mobile access server, in accordance with the principles of the present invention. With reference to Fig. 6, at step S601, the Home mobile access server (MAS) 305 checks to determine whether the Home mobile access server (MAS) Find Request, requesting the Internet protocol address of a particular mobile node, has been received from an arbitrary mobile access server (MAS) through the Internet 320.

At step S617, when the Home mobile access server (MAS) Find Request message has not been received, the Home mobile access server 305 performs a function corresponding to the circumstances. At step S603, when the message has been received, the Home mobile access server 305 analyses the received message and, based on this analysis, it acquires the physical address, that is, the medium access control (MAC) address, for identifying the particular mobile node and also information on the server that transmitted the Home mobile access server Find Request message, that is, the medium access control (MAC) address, the Internet protocol address, and other information. As mentioned before, the particular mobile node is presumed to be the mobile node 301-2.

At step S605, based on the medium access control (MAC) address of the mobile node 301-2 obtained at step S603, the Home mobile access server 305 checks to

determine whether there is information on the mobile node 301-2 in its own database. At step S619, when there is no such information, the Home mobile access server 305 performs a corresponding function appropriate for the circumstances.

At step S607, when there is the information on the mobile node 301-2, the Home mobile access server 305 acquires the mobile node's Internet protocol address from the database, and generates a response to the Home mobile access server Find Request, and transmits the response. Here, the response message includes information on the Internet protocol address of the mobile node 301-2 and the medium access control (MAC) address of the Home mobile access server.

At step S609, later, the Home mobile access server 305 updates the information for supporting mobility of the mobile node 301-2 at the request of the foreign mobile access server 315. In other words, the Home mobile access server 305 updates the mobile node's location registration information.

At step S611, the Home mobile access server 305 exchanges transceived data on the mobile node 301-2 through the foreign mobile access server 315. More specifically, the transmitted data from the mobile node 301-2 is sent to the other party, also referred to as the communication node, through the fourth access point 312, the foreign mobile access server 315, and the Home mobile access server 305, and the data being transmitted from the other party is sent back to the mobile node 301-2 through the Home mobile access server 305, the foreign mobile access server 315, and the fourth access point 312.

At step S613, the foreign mobile access server 315 checks to determine whether the communication for the mobile node 301-2 has been terminated. At step S615, when the communication has been terminated between the mobile node 301-2 and the communication node, the Home mobile access server 305 updates information on the mobile node 301-2 in the database, and ends the whole procedure.

In conclusion, embodiments of the present invention introduce a method for supporting a mobile node's mobility through access points and mobile access servers only, without using a complicated protocol or making additional changes in the mobile node. In addition, embodiments of the present invention advantageously changes a data routing path to a new access point by figuring out the motion of the mobile node at a medium access control layer.

While the present invention has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative apparatus and method, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the scope of the general inventive concept.

CLAIMS:

1. A method of communication for a mobile node, the method comprising:

moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first and second subnetworks being networked to each other through the Internet, the first subnetwork being assigned a first Internet protocol address, the second subnetwork being assigned a second Internet protocol address different from the first Internet protocol address;

broadcasting a first message from a second mobile access server of the second subnetwork, the first message including a medium access control address of the mobile node;

acquiring an address of the second mobile access server from the first message, said acquiring being performed by a first mobile access server of the first subnetwork;

transmitting a second message from the first mobile access server to the second mobile access server in response to the first message, the second message including an address of the first mobile access server and an Internet protocol address of the mobile node; and

when the mobile node is in the second subnetwork, routing first data from the mobile node through the second mobile access server and then through the first mobile access server.

2. The method of claim 1, wherein the first message conforms to a reverse address resolution protocol.

3. The method of claim 1, further comprising:

routing second data through the first mobile access server and then through the second mobile access server and then to the mobile node.

4. The method of claim 1, wherein said broadcasting of the first message is performed when the mobile node is communicating with a second node during said moving.

5. The method of claim 4, wherein the first data is routed to the second node after being routed through the first mobile access server.

6. The method of claim 5, further comprising:

when the mobile node is in the second subnetwork, routing second data from the second node through the first mobile access server and then through the second mobile access server and then to the mobile node.

7. The method of claim 6, wherein the first message conforms to a reverse address resolution protocol.

8. The method of claim 7, wherein the first subnetwork and the first mobile access server correspond to a home subnetwork and a home mobile access server respectively, and the second subnetwork and the second mobile access server correspond to a foreign subnetwork and a foreign mobile access server respectively.

9. A handover processing method for a mobile node, the method comprising:

moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first

and second subnetworks being networked to each other through the Internet and the first and second subnetworks not being assigned the same Internet protocol address;

transmitting a handover request message from an access point of the second subnetwork to a second mobile access server of the second subnetwork, the handover request message including a medium access control address of the mobile node;

broadcasting a first message from the second mobile access server in response to the handover request message, the first message including a medium access control address of the mobile node;

when a second message is received in response to the first message, acquiring an address of a first mobile access server of the first subnetwork and an Internet protocol address of the mobile node from the second message; and

when the mobile node is in the second subnetwork, routing data from the mobile node through the address of the first mobile access server.

10. The method of claim 9, wherein said transmitting of the handover request message is performed when the mobile node is communicating with a second node during said moving.

11. The method of claim 10, wherein the data is routed to the second node after being routed through the first mobile access server.

12. The method of claim 11, wherein the first message conforms to a reverse address resolution protocol.

13. A handover processing method for a mobile node, the method comprising:

moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first and second subnetworks being networked to each other through the Internet and the first and second subnetworks not being assigned the same Internet protocol address;

receiving a first message at a first mobile access server of the first subnetwork, the first message including an address of the first mobile node;

acquiring an address of a second mobile access server of the second subnetwork from the first message received, said acquiring being performed by the first mobile access server;

transmitting a second message to the second mobile access server in dependence upon said acquiring of the address of the second mobile access server, the second message including an address of the first mobile access server and an Internet protocol of the mobile node; and

routing data from the mobile node through the address of the second mobile access server acquired by the first mobile access server.

14. The method of claim 13, wherein the address of the first mobile node included in the first message is a medium access control address.

15. The method of claim 14, wherein the first subnetwork corresponds to a home subnetwork for the mobile node and the second subnetwork corresponds to a foreign subnetwork for the mobile node.

16. An apparatus for mobile communication, the apparatus comprising:

a first subnetwork being in a wireless local area network, being in communication with the Internet, and being assigned a first Internet protocol address;

a second subnetwork being in the wireless local area network, being in communication with the Internet, and being assigned a second Internet protocol address different from the first Internet protocol address;

a foreign mobile access server being mounted in said second subnetwork and broadcasting a first message including a medium access control address of a mobile node when the mobile node moves to said second subnetwork from said first subnetwork; and

a home mobile access server being mounted in said first subnetwork, acquiring an address of said foreign mobile access server from the first message, said home mobile access server transmitting a second message in response to the first message, the second message including an address of said home mobile access server and an Internet protocol address of the mobile node to said foreign mobile access server; wherein

said foreign mobile access server is arranged to route first data from the mobile node to the home mobile access server; and

said home mobile access server is arranged to route second data through the foreign mobile access server and then to the mobile node.

17. The apparatus of claim 16, wherein the routing of the first data from the mobile node to the home mobile access server is performed when the mobile node is in the second subnetwork.

18. The apparatus of claim 17, wherein the routing of the second data through the foreign mobile access

server and then to the mobile node is performed when the mobile node is in the second subnetwork.

19. The apparatus of claim 16, wherein the first message is broadcast only when the mobile node is in communication with a second node when the mobile node is moved to said second subnetwork.

20. The apparatus of claim 19, wherein said home mobile access server receives the second data from the second node, the first data being routed to the second node from said home mobile access server.

21. A method substantially as hereinbefore described with reference to the accompanying drawings.

22. Apparatus constructed and arranged substantially as hereinbefore described with reference to the accompanying drawings.

Application No: GB 0304146.4
Claims searched: All

Examiner: Dr Jan Miasik
Date of search: 29 July 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1 - 7, 9 - 13, 16 - 20	WO 2002/017670 A1 (Nokia Corp.): see whole document, particularly p. 7, lines 14 - 35, p.8, lines 22 - 32, p. 16, lines 12 - 14, p. 17, lines 18 - 24 and the abstract
A		WO 2001/099457 A1 (Nokia Networks OY): see whole document

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[v]:

H4L

Worldwide search of patent documents classified in the following areas of the IPC[7]:

H04L, H04Q

The following online and other databases have been used in the preparation of this search report :

Online: EPODOC, WPI, JAPIO